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FILING DATE: *November 17, 2003*
RELATED PCT APPLICATION NUMBER: *PCT/US04/38172*

Certified by

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

22154 60/520,868 U.S.PTO 111703

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TITLE OF THE INVENTION (280 characters max)

HYDROFORMING USING HIGH PRESSURE PULSATION DURING FLUID INTENSIFICATION CYCLE

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ENCLOSED APPLICATION PARTS *(check all that apply)*

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☐ Application Data Sheet. See 37 CFR 1.76

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Respectfully submitted,

SIGNATURE

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Date 11/18/2003

REGISTRATION NO. *(if appropriate)* 45,639

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P19LARGE/REV05

HYDROFORMING USING HIGH PRESSURE PULSATION DURING FLUID INTENSIFICATION CYCLE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method of hydroforming metal components, and more particularly to a method of hydroforming metal components using a high pressure fluid having a pulse applied to the fluid.

Description of the Related Art

Hydroforming methods and processes are commonly known in the art for shaping tubular metal blanks, as well as, metal sheets. A typical hydroforming method used for shaping a tubular metal blank involves placing a tubular metal blank within a die cavity and introducing high pressure fluid within the interior of the blank causing the blank to expand outwardly to conform to the surface of the die cavity. Hydroforming metal parts has several advantages over typically used stamping operations to produce shaped metal components. Stamping operations typically involve pressing a metal part into a desired shape using a large hydraulic press to form the metal part. However, parts created using such a hydraulic press often have inconsistencies due to the characteristics of the forming operation. For example, metal parts formed using a stamping operation exhibit hardening of various portions of the part, usually at bend points or contours, resulting in material inconsistencies throughout the part. Also, metal parts having complex geometries cannot be produced in a single stamping operation due to inherent limitations in a stamping process. Therefore, welding and joining operations are often necessary to form a complex part, adding to the total cost of the part.

The process of hydroforming is capable of better repetition and precision when configuring complex shaped parts. As a result, complex parts can be formed in a single forming operation without the need for welding or joining processes which can lead to material distortions inherent in the joining processes.

Generally, hydroforming of sheet metal involves placing a sheet metal blank within a die wherein a pressurized fluid is introduced into the die cavity pressing the sheet metal against the contour of the die to form a shaped part.

While hydroforming produces parts having complex geometries using both tubular and sheet metal blanks, there are limitations to a hydroforming process including the thinning of base metal material of the blank during the forming process. Also, hydroformed parts may exhibit wrinkling or local deformations produced on the part during a forming process.

There is therefor a need in the art for a hydroforming process that limits the thinning of the base material of a blank, as well as improves the flow of material during the process resulting in a part having less material thickness variation over parts produced using conventional hydroforming processes.

SUMMARY OF THE INVENTION

A method of hydroforming a metal part that includes the steps of: placing a part to be formed within a die, closing the die to enclose the part to be formed, introducing a high pressure fluid to an interior of the die for expanding the part against an interior surface of the die, the high pressure fluid having a pulse applied thereto for increasing a material flow of the part within the die during the hydroforming operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows schematically a preferred embodiment of a hydroforming device utilized by the method of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figure 1, there is shown a preferred embodiment of a device 5 used in the method of hydroforming of the present invention. The hydroforming device 5 includes a variable frequency drive motor 10 connected through a bearing journal 15 to a connecting rod 20 attached to a piston plunger 25. The piston 25 is disposed within a cylinder 30 and is sealed within the cylinder 30 by an appropriate piston seal 35. The device 5 moves the cam operated piston 25 displacing fluid to create a frequency or pulse. The cylinder 30 is connected to a fluid line 40 that introduces the pressurized fluid into the forming die to create a formed metal part. The pulse or wave is generated by the variable frequency drive motor 10 connected to the cam operated piston 25.

In a preferred aspect of the present invention, the variable frequency drive motor 10 has a frequency range of from 5 to 60 hertz. The frequency range of from 5 to 60 hertz results in a frequency fluid volume displacement in the range of from .001 to 5 liters of water. The piston 25 amplitude preferably has a range of from 1 to 50 mm resulting in a pressure amplitude in the range of from 5 to 500 bar. The frequency pressure range preferably, is from 5 to 1500 bar with a frequency duration of preferably 30 seconds. Through put speeds for parts formed by the hydroforming operation preferably are in the range of from 5 to 60 seconds.

As noted above, tubular structures as well as sheet materials may be utilized as blank materials for the hydroforming operation of the present invention.

While a preferred device is shown in Figure 1 for introducing the pulse into the hydroforming fluid, other methods or devices may be utilized by the present invention. For example, valves associated with the fluid line 40 leading to the forming die used in the hydroforming operation can be manipulated or oscillated; thereby introducing a frequency or pulse to the hydroforming fluid, preferably in the range of the characteristics outlined above with respect to the preferred embodiment.

The method of the present invention includes placing a part to be formed within a hydroforming die, closing the die, and then introducing a high pressure fluid to an interior of the die, the high pressure fluid having a pulse applied thereto. The high pressure fluid expands the part against an interior surface of the die resulting in a formed metal part. As the high pressure fluid is introduced to the die generally, the metal part begins expanding against the die surface. Generally in a conventional hydroforming operation, a static pressure of from 300 to 500 bar is utilized to expand the metal against the die surface. The conventional hydroforming operation or method, as stated above uses a constant or static pressure resulting in a constant expansion of the metal against the surface of a die.

The method of the present invention utilizes a wave or pulse flow of pressure; thereby increasing the material flow in the cavity or die by not constantly expanding the metal blank, resulting in a more consistent wall thickness, especially in portions of a part having a complex curvature that would often see thinning when a constant pressure hydroforming fluid is applied to the die.

Many modification and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. A method of hydroforming a metal part comprising the steps of:

placing a part to be formed within a die;

closing the die to enclose the part to be formed;

introducing a high pressure fluid to an interior of the die for expanding the part against an interior surface of the die, the high pressure fluid having a pulse applied thereto for increasing a material flow of the part within the die.

ABSTRACT

A method of hydroforming a metal part. The part is placed within a die. The die is closed and a high pressure fluid is introduced to an interior of the die for expanding the part against an interior surface of the die. The high pressure fluid has a pulse applied thereto for increasing a material flow of the part within the die during the hydroforming operation.

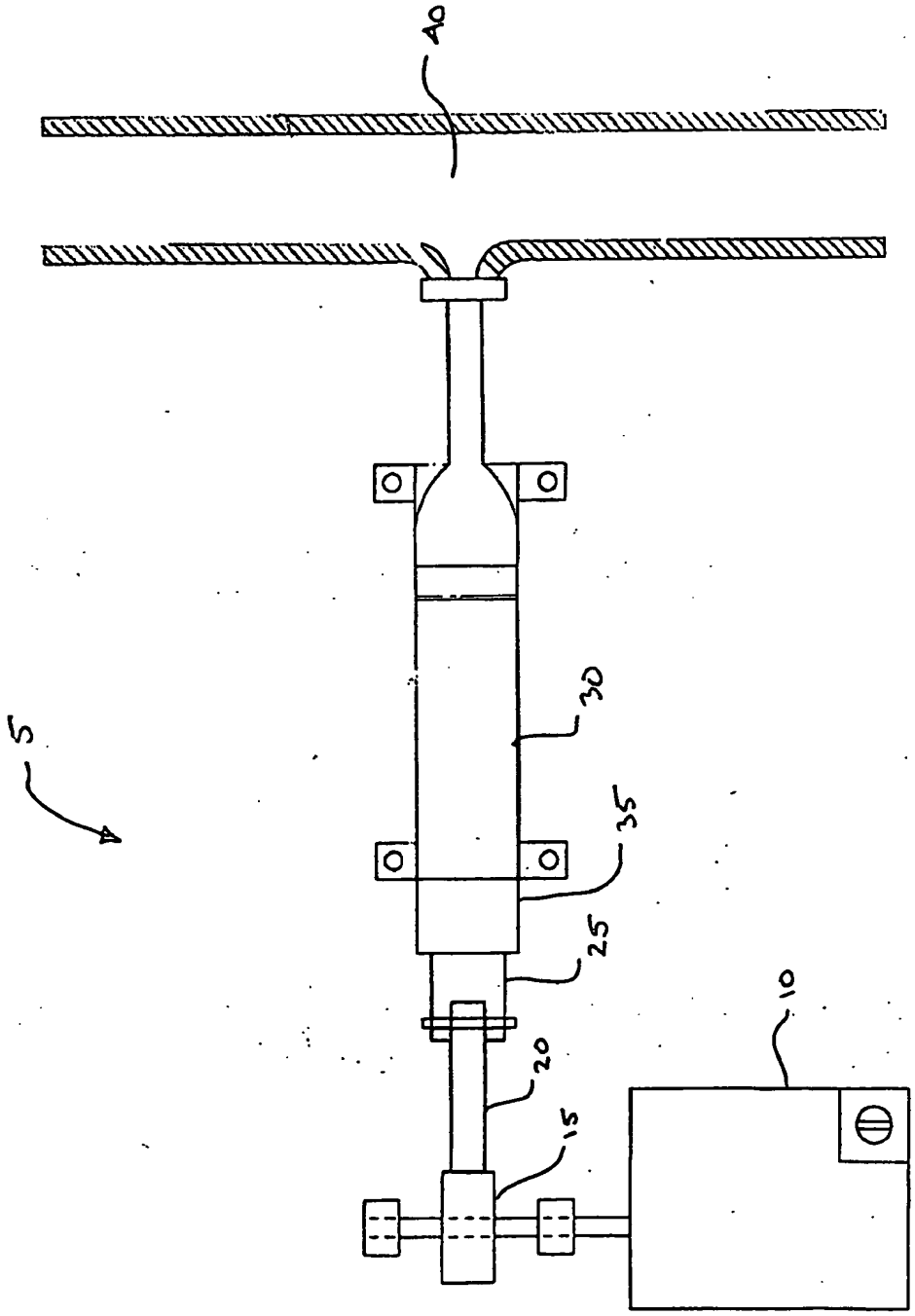

FIGURE 1

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